

REMARKS

This is a full and timely response to the non-final Office Action mailed October 17, 2007, in which Applicants' Claims 1-20 were rejected. By way of this Response, Applicants' Claims 1-6, 9, 11, and 13 have been amended. Reconsideration of pending Claims 1-20 is respectfully requested in view of the following remarks.

I. Claim Rejections - 35 U.S.C. § 112

On page 2, the Office Action rejects Applicants' Claims 17 and 18 under 35 U.S.C. § 112, second paragraph, as failing to set-forth that which Applicants regard as the subject matter of their invention. In particular, the Office Action states that the word "mass" appearing in Claims 17 and 18 should be replaced with the word "weight" since "mass remains constant regardless of vehicle position or attitude."

Applicants respectfully submit that the term "mass," and more generally the phrase "mass characteristics," is properly utilized in Claims 17 and 18. While it is true that the mass remains constant regardless of vehicle position or attitude, spacecraft mass may still change over the operational lifetime of the spacecraft due to fuel usage, the release or capture of cargo, and the other such occurrences. See Applicants' Paragraph 0003. A spacecraft's mass is directly related to degree to which the spacecraft will resist a change of speed or direction. Applicants' Claims 17 and 18 thus properly modify Applicants' independent Claim 14 by adding additional steps relating to ascertaining the spacecraft's current mass when determining the optimal manner in which to reorient the spacecraft's CMG array.

It is thus respectfully submitted that the term “mass” is used appropriately in Applicants’ Claims 17 and 18 and, consequently, that the rejection asserted against Claims 17 and 18 under 35 U.S.C. § 112, second paragraph, should be withdrawn.

II. Claim Rejections - 35 U.S.C. § 102(a)

On page 2, the Office Action rejects Applicants’ Claims 1-9, 14, 15, 19, and 20 under 35 U.S.C. § 102(a) as anticipated by US Pub. No. 2002/0145077 (the Shultz reference). Applicants address each of the rejected claims, in turn, below.

A. Applicants’ Amended Independent Claim 1

Applicants have amended independent Claim 1 to further distinguish over the Shultz reference and the other references of record. Applicants’ amended independent Claim 1 is directed to a CMG including: (i) a rotor, (ii) a gimbal supporting the rotor, (iii) a mount, (iv) a base rotatably coupled to the mount and supporting the gimbal, and (v) a drive mechanism for rotating the base. As amended, Applicants’ independent Claim 1 specifies that the CMG further includes: (vi) a plurality of detents formed in the rotatable base, and (vii) a locking pin fixedly coupled to the mount and configured to lock and unlock the base by selectively engaging different ones of plurality of detents. Support for this amendment may be found in Applicants’ FIG. 5A, FIG. 5B, and Paragraphs 0022-0025, which show and describe a CMG assembly including a locking pin 85 and a base 78 having a plurality of detents 86 formed therein.

The Shultz reference fails to teach multiple structural elements recited in Applicants’ independent Claim 1, as amended. As shown and described in Shultz FIG. 2A and Paragraphs 0027-0028, gyroscope 122a utilizes a motor 218 to rotate outer gimbal 216 relative to base 128 and a brake 224 to decrease or stop the rotation of gimbal

216. The Shultz reference does not teach or suggest a plurality of detents formed in base
128. Nor does the Shultz reference teach or suggest a locking pin coupled to the CMG's
mount and configured to selectively engage different ones of the plurality of detents to
lock and unlock the rotatable base.

It is well-established that a reference must teach every element of a claim to properly anticipate the claim under 35 U.S.C. § 102(a). MPEP § 2131. Furthermore, "the identical invention must be shown in as complete detail as is contained in the... claim." MPEP § 706.02 citing *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The Shultz reference fails to teach at least two structural features recited in Applicants' amended independent Claim 1. It is therefore respectfully submitted that Applicants' amended independent Claim 1 is not anticipated by the Shultz reference under 35 U.S.C. § 102(a).

As no additional rejections have been asserted against Applicants' amended independent Claim 1, it is further respectfully submitted that Claim 1 is allowable.

B. Applicants' Amended Dependent Claim 2

Applicants' dependent Claim 2 has been amended to further distinguish over the Shultz reference and the other references of record. As amended, Applicants' amended dependent Claim 2 recites that the plurality of detents is formed in an outer circumferential portion of the base such that each detent in the plurality of detents passes by the locking pin as the base is rotated relative to the mount.

As explained above in conjunction with Applicants' independent Claim 1, the Shultz reference fails to teach a plurality of detents formed in a CMG's rotatable base. It should thus be clear that Shultz reference likewise fails to teach a plurality of detents

formed in an outer circumferential portion of the base and arranged such that each detent in the plurality of detents passes by the locking pin as the base is rotated. Considering this, and considering that Applicants' dependent Claim 2 depends directly from amended independent Claim 1, it is respectfully that Claim 2 is not anticipated by the Shultz reference under 35 U.S.C. § 102(a).

C. Applicants' Amended Independent Claim 3

Applicants' independent Claim 3 has been amended to more clearly recite that which Applicants regard as their invention. Applicants' Claim 3 is generally directed toward an apparatus for controlling spacecraft (S/C) momentum using control moment gyros (CMGs). The apparatus includes, in relevant part: (i) an array of three or more CMGs, (ii) a plurality of mechanical locking features formed in or disposed on the base of a first CMG in the array of three or more CMGs, and (iii) a releasable locking mechanism disposed proximate the first CMG. According to Claim 3, the releasable locking mechanism is configured to selectively lock the position of the base of the first CMG in any one of a number of discrete, indexed rotational positions each corresponding to a different mechanical locking feature in the plurality of mechanical locking features. An example of such a CMG is shown in Applicants' FIGs. 5A and 5B, which collectively illustrate a CMG assembly including a locking mechanism 84 that may lock a rotatable base 78 in any one of a number of discrete, indexed rotational positions corresponding to detents 86.

The Shultz reference does not teach or suggest a spacecraft momentum control apparatus including a plurality of mechanical locking features formed in or disposed on the base of a first CMG in an array of CMGs. Nor does the Shultz reference teach or

suggest a releasable locking mechanism configured to selectively lock the position of the base in any one of a number of discrete, indexed rotational positions each corresponding to a different one of a plurality of mechanical locking features. Instead, as shown in Shultz FIG. 2A and described in Shultz Paragraph 00028, the Shultz reference discloses a brake 224 (e.g., a disc brake or a dog clutch brake) that may ostensibly be utilized to lock gyroscope 122a in an infinite number of non-indexed rotational positions.

It should thus be appreciated that the Shultz reference fails to teach or suggest multiple structural features recited in Applicants' amended independent Claim 3. Thus, the Shultz reference should not be relied upon to establish a *prima facie* case of anticipation under 35 U.S.C. § 102(a). It is therefore respectfully submitted that Applicants' amended independent Claim 3 is allowable.

D. Applicants' Amended Dependent Claim 4

Applicants' dependent Claim 4 has been amended to recite that each CMG in the array of three or more CMGs is a single gimbal axis CMG. Support for this amendment may be found in Applicants' FIGs. 1A-5B and the attendant description, which generally show and describe various CMG arrays comprising single gimbal axis CMGs. By comparison, the Shultz reference is directed to and discusses only dual gimbal axis CMGs. The Shultz reference, then, does not disclose a CMG array including multiple single axis CMGs as recited in Applicants' amended dependent Claim 4. Considering this, and considering that Applicants' amended Claim 4 depends directly from Applicants' amended independent Claim 3, it is respectfully submitted that Claim 4 is allowable.

E. Applicants' Dependent Claims 5-9

Applicants' Claims 5-9 each depend, either directly or indirectly, from Applicants' amended independent Claim 3 and are thus believed allowable therewith. Please note that Applicants' Claims 5, 6, and 9 have been amended to accord with terminology introduced into Applicants' independent Claim 3 by way of amendment.

F. Applicants' Independent Claim 14

Applicants' independent Claim 14 is directed to a method of improving momentum control of a space vehicle by reorienting a control moment gyro (CMG) array. In relevant part, the method includes the steps of: (i) identifying which CMGs of the array are working, and (ii) determining a second array orientation having more favorable vehicle control characteristics.

In rejecting Applicants' independent Claim 14, the Office Action states that both of the steps set-forth above are taught in Shultz Paragraph 0029. For ease of reference, Shultz Paragraph 0029 is reproduced below in its entirety.

A processor 130 controls the motion of motors 212 and 218 and brake 224. Processor 130 also receives information about the position of gyroscope 122 from sensor 220 and adjusts the motion of gyroscope 122 by sending signals to motor 218 and brake 224. For example, when sensor 220 detects that inner gimbal 214 is at a predetermined angle of rotation such as approximately $+45^{\circ}$, processor 130 sends a signal to brake 224 to stop the rotation of outer gimbal 216. When inner gimbal 214 is at another predetermined angle of rotation, such as approximately -45° , processor 130 sends a signal to brake 224 to release outer gimbal 216 to allow it to rotate. Predetermined angles may be any suitable angle between -90° and $+90^{\circ}$. Gyroscope 122a may be coupled to a similarly constructed gyroscope 122b with two degrees of freedom. Processor 130 controls the motion of gyroscopes 122a and 122b to generate a torque about axes 250 and 251 in order to direct object 110 about control axis 112.

While stating that "processor 130 also receives information about the position of gyroscope 122," Shultz Paragraph 0029 provides no indication that processor 130, or any

other component of the momentum control system disclosed in Shultz, identifies non-operational CMGs within the CMG array. Therefore, Paragraph 0029 does not teach the step of identifying which CMGs of in an array of CMGs are working as recited in Applicants' independent Claim 14. Nor does Paragraph 0029 teach the step of determining a second array orientation having more favorable vehicle control characteristics. Furthermore, Applicants respectfully submit that no other portion of the Shultz references teaches either of these two claimed steps.

In view of the above, it should be appreciated that the Shultz reference fails to teach every step recited in Applicants' independent Claim 14 as required to establish a *prima facie* case of anticipation under 35 U.S.C. § 102(a). Accordingly, it is respectfully submit that rejection asserted against Applicants' independent Claim 14 as anticipated by the Shultz reference under 35 U.S.C. § 102(a) should be withdrawn.

As no additional rejections have been asserted against Applicants' independent Claim 14, it is further respectfully submitted that Claim 14 is allowable.

G. Applicants' Dependent Claims 15, 19, and 20

Applicants' Claims 15, 19, and 20 are each believed allowable in view of their dependency from Applicants' independent Claim 14. Applicants also note that Applicants' Claims 15, 19, and 20 also recite steps that are not taught in the Shultz reference. Applicants' dependent Claim 15, for example, recites the step of determining the best vehicle state for array reorientation and adjusting CMG momentum for minimum negative vehicle impact during reorientation of the array. The Office Action cites Shultz Paragraphs 0038-0039 as teaching this step; however, Shultz Paragraphs 0038-0039 describe only the general process of releasing brakes 224 (referred to as a "reset mode"),

rotating outer gimbals 216, and stopping outer gimbals 216 near a desired rotational position. Shultz Paragraph 0038-0039 do not describe rotating outer gimbals 216 at any particular time or any particular spacecraft state so as to provide “minimum negative vehicle impact” as recited in Applicants’ dependent Claim 15.

III. Claim Rejections - 35 U.S.C. § 103(a)

On page 6, the Office Action rejects Applicants’ Claims 17 and 18 under 35 U.S.C. § 103(a) as being unpatentable over the Shultz reference in view of Applicants’ alleged admitted art appearing in Paragraph 0030.

Applicants’ dependent Claims 17 and 18 are believed allowable in view of their dependency from Applicants’ independent Claim 14, which is believed allowable for the reasons discussed above.

Next, on page 6, the Office Action rejects Applicants’ Claims 10-13 and 16-18 under 35 U.S.C. § 103(a) as being unpatentable over the Shultz reference taken in view of US Pat. No. 6,285,927 (the Li reference).

Applicants note initially that the Li reference is directed to a system and method for determining/controlling spacecraft attitude and not to a system for reorienting at least one CMG in a CMG array as described in Applicants’ Specification and recited in Applicants’ claims. Furthermore, the Li reference does not provide any of the features recited in Applicants’ claims and pointed-out above as lacking in the Shultz reference. This notwithstanding, Applicants’ Claims 10-13 and Claims 16-18 are believed allowable in view of their dependency from Applicants’ amended independent Claim 3 and Applicants’ independent Claim 14, respectively. Please note that Applicants’ Claims 11

and 13 have been amended to accord with terminology introduced into Applicants' independent Claim 3 by way of amendment.

IV. Conclusion

Considering the foregoing remarks and amendments, Applicants respectfully submit that the Application is now in condition for allowance.

If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the below-listed number.

If, for some reason, Applicants have not paid a sufficient fee for this response, please consider this as authorization to charge INGRASSIA, FISHER & LORENZ, PC, Deposit Account No. 50-2091 for any fee which may be due.

Respectfully submitted,

INGRASSIA, FISHER & LORENZ

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/JUSTIN J. LEACH/

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